

*Examiner's Copy*

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TI **Steel** sheets having good necking ability and compressive  
strength for manufacture of DI **cans**  
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PI	JP 06306536	A2	19941101	JP 1993-99841	19930426
AB	The <b>steel</b> sheets contain C 0.0005-0.0700, Si .ltoreq.0.30, Mn 0.05-1.00, P .ltoreq.0.030, S .ltoreq.0.025, sol. Al 0.002-0.100, N .ltoreq.0.0100, B .ltoreq.(0.0010 + 1.8N), and Nb and/or Ti .ltoreq.0.05%, and have a <b>grain</b> size no. .gtoreq.9.0 and a yield point .gtoreq.39 kg/mm2 measured after being prestretched at <b>elongation</b> 3% and heated at 200.degree. for 10 min and .ltoreq.62 kg/mm2 measured after being prestretched at <b>elongation</b> 50% and heated at 200.degree. for 10 min. The <b>steel</b> sheets are manufd. by cold rolling of a hot-rolled strip at draft 85-95%, recrystn. annealing at temps. between the recrystn. temp. and 830.degree., cooling to room temp. until dissolved C <5 ppm, and temper rolling to produce a strain 10-40%.				

# PATENT ABSTRACTS OF JAPAN

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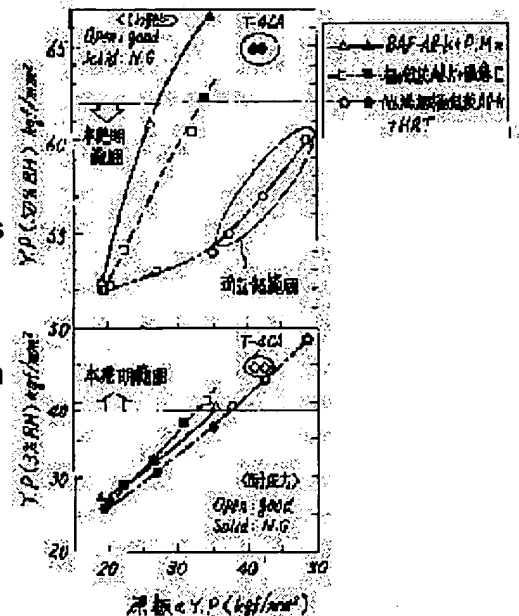
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(54) SURFACE TREATED ORIGINAL SHEET FOR DI CAN EXCELLENT IN PRESSURE WITHSTANDING STRENGTH AND NECKED-IN PROPERTY AND ITS PRODUCTION

(57)Abstract:

PURPOSE: To provide a surface treated original sheet for a DI can excellent in pressure withstanding strength and necked-in properties and to provide its producing method.

CONSTITUTION: This surface treated original sheet for a DI can excellent in pressure withstanding strength and necked-in properties is a one having a compsn. contg. 0.0005 to 0.0700% C,  $\leq 0.30\%$  Si, 0.05 to 1.00% Mn,  $\leq 0.030\%$  P,  $\leq 0.025\%$  S, 0.002 to 0.100% sol.Al,  $\leq 0.0100\%$  N, 0 to  $(0.0010+1.8 \times N\%)$  B and 0 to 0.050% of one or both of Nb and Ti, and the balance iron with inevitable impurities, and in which Y. P (3% BH) is regulated to  $\geq 39\text{kgf/mm}^2$  and Y. P (50% BH) 15 regulated to  $\leq 62\text{kgf/mm}^2$ , or, this is a surface treated original sheet for a DI can good in flanging properties and excellent in pressure withstanding strength and necked in properties in which G. S no is regulated to  $\geq 9.0$ . This is produced in ordinary continuous annealing equipment and overaging treating equipment by a continuous annealing method, a box annealing method and an extremely compact continuous annealing method.



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CLAIMS

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[Claim(s)]

[Claim 1] At weight %, it is C : 0.0005 - 0.0700%, Si:  $\leq 0.30\%$ , Mn: 0.05-1.00%, P :  $\leq 0.030\%$ , S :  $\leq 0.025\%$ , sol.aluminum: 0.002-0.100%, N :  $\leq 0.0100\%$ , B Both :  $0-(0.0010+1.8 \times N \%)$  %, and Nb and Ti : [ both / either or ] / 0.050%, It consists of a remainder unescapable impurity and iron, and Y.P (3%BH) is 2 39 kgf(s)/mm. Y.P (50%BH) 2 62 kgf(s)/mm above. Surface treatment negative for DI cans excellent in the pressure resistance characterized by being the following, and necked-in nature.

[Claim 2] At weight %, it is C : 0.0005 - 0.0700%, Si:  $\leq 0.30\%$ , Mn: 0.05-1.00%, P :  $\leq 0.030\%$ , S :  $\leq 0.025\%$ , sol.aluminum: 0.002-0.100%, N :  $\leq 0.0100\%$ , B It consists of a remainder unescapable impurity and iron 0 to 0.050 G.Sno Both :  $0-(0.0010+1.8 \times N \%)$  %, and Nb and Ti : or more by 9.0 [ both / either or ] Y. P (3%BH) is 2 39 kgf (s)/mm. Y.P (50%BH) is 2 62.kgf(s)/mm above. Surface treatment negative for DI cans excellent in the good pressur resistance and necked-in nature of the flange processability characterized by being the following.

[Claim 3] At weight %, it is C : 0.0005 - 0.0060%, Si:  $\leq 0.30\%$ , Mn: 0.05-1.00%, P :  $\leq 0.030\%$ , S :  $\leq 0.025\%$ , sol.aluminum: 0.002-0.100%, N :  $\leq 0.0100\%$ , B Both :  $0-(0.0010+1.8 \times N \%)$  %, and Nb and Ti : [ both / either or ] / 0.03%, Hot-roll and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -830 degree C by the continuous-annealing method. It cools to a room temperature and is ppm about the amount of dissolution C in a steel plate. After considering as the following, temper rolling gives distortion of 40% or less 10% or more. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm 2 It is Y.P (50%BH) 62 kgf (s)/mm above 2 The manufacture method of the surface treatment negative for DI-cans excellent in the pressure resistance characterized by adjusting to below, and necked-in nature.

[Claim 4] At weight %, it is C : 0.0020 - 0.0045%, Si:  $\leq 0.30\%$ , Mn: 0.05-1.00%, P :  $\leq 0.030\%$ , S :  $\leq 0.025\%$ , sol.aluminum: 0.002-0.100%, N :  $\leq 0.0100\%$ , B Both :  $0-(0.0010+1.8 \times N \%)$  %, and Nb and Ti : [ both / either or ] / 0.01%, Hot-roll and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -830 degree C by the continuous-annealing method. It cools to a room temperature and is ppm - 30 ppm about the amount of dissolution C in a steel plate. You make it remain. Then, temper rolling gives distortion of 30% or less 5% or more by the pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm 2 Above, Y. The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting P (50%BH) to two or less [ 62 kgf(s)/mm ], and necked-in nature.

[Claim 5] The manufacture method of the surface treatment negative for DI cans excellent in the good pressure resistance of the flange processability beyond G.Sno:9.0 characterized by hot-rolling in a method a claim 3 or given four by finishing above 890 degrees C at the time of hot rolling, and considering as a hot-rolling steel strip, and neck in nature.

[Claim 6] At weight %, it is C : 0.0005 - 0.0700%, Si:  $\leq 0.30\%$ , Mn: 0.05-1.00%, P :  $\leq 0.030\%$ , S :  $\leq 0.025\%$ , sol.aluminum: 0.002-0.100%, N :  $\leq 0.0100\%$ , B Both :  $0-(0.0010+1.8 \times N \%)$  %, and Nb and Ti : [ both / either or ] / 0.050%, Hot-roll and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -750 degree C by the box annealing method. Cool to a room temperature and temper roll gives distortion of 40% or less 10% or more by the pace of expansion after that. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm 2 It is Y.P (50%BH) 62 kgf(s)/mm above 2 The manufacture method of the surface treatment negative fo DI cans excellent in the pressure resistance characterized by adjusting to below, and necked-in nature.

[Claim 7] At weight %, it is C : 0.0005 - 0.0060%, Si:  $\leq 0.30\%$ , Mn: 0.05-1.00%, P :  $\leq 0.030\%$ , S :  $\leq 0.025\%$ , sol.aluminum: 0.002-0.100%, N :  $\leq 0.0100\%$ , B Both :  $0-(0.0010+1.8 \times N \%)$  %, and Nb and Ti : [ both / either or ] / 0.050%, Hot-roll and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. It faces cold-rolling at 85 - 95% of rate of cold rolling, and carrying out recrystallization annealing after that. Temperature region at least 500 degrees C or more is heated at recrystallizing-temperature -920 degree C b the 100-2500 degrees C [ /s ] heating rate. Carry out 0-10sec stay in the temperature region, perform recrystallization annealing, and it cools to a room temperature. Then, temper rolling gives distortion of 40% or less 5% or more by th pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup> The manufacture method of the surface treatment negative for DI cans excellent in the good pressure resistance of th flange processability beyond G.Sno:9.0 characterized by adjusting to below, and necked-in nature.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] In the surface treatment negative for DI cans with which tinning is performed, this invention relates to the surface treatment negative for DI cans and the manufacture method excellent in the pressure resistance and necked-in nature of DI can which can secure a predetermined pressure resistance, when the gage down of the bo thickness of the black plates for DI cans is carried out (it is the gage down to 0.245mm to 0.220mm of the present condition about the present board thickness).

[0002] In addition, the abbreviation used on these specifications has the following meaning.

G. Sno : the grain-size-number number of a negative

Y. -- P(3%BH): -- Y.PY.P(50%BH): after performing after [ an additional rolling prestrain ] BH heat treatment of 3% of paces of expansion -- 50% of paces of expansion Y.PBH heat treatment after performing after [ an additional rolli prestrain ] BH heat treatment: 200 degree-Cx10min Heat treatment [0003]

[Description of the Prior Art] the aluminum killed (aluminum-K) steel of the homaxial grain which improved the earring nature manufactured by the box annealing method the surface treatment negative for DI cans with which tinning is performed is shown in JP,61-243124,A and JP,53-123644,A in the past -- the aluminum-K steel of a certai extension grain was applied for many years, and the degree of temper was the steel plate of non-aging in the elasticit of one to 2 (it is described as T-2 the following T-1) grade Then, the board thickness of a steel plate was decreased a lightweight-ization of DI can was advanced. In order to compensate the shortage of a pressure resistance to the intern pressure of the bottom section of DI can in performing this lightweight-ization, it has been changed and applied to th steel plate with BH nature by hard [ which is called T-4CA which manufactures the aluminum-K steel currently manufactured from the former by continuous annealing ].

[0004] recently, while progress with the much more lightweight-izing of DI can is desired, for the cost cut of alumin (aluminum) board used for a can top, minor diameter-ization is performed and multi-stage necked-in processing give the path of the top section (necked-in section) of DI can -- having -- coming -- just -- being alike -- four-step necked-processing began to be adopted However, although T-4CA currently supplied as a present material for DI cans is enough as the pressure resistance of a can, four-step necked-in processing to which the rate of necked-in one become severer at the time of minor-diameter[ as / whose path of a can top is 204phi, i.e., (2+4/16), phi inch, for example ]-izing must be performed, there is a problem that a wrinkling occurs, and it is in the situation that progress has stagnated. On the other hand, although the needs of a gage down of the surface treatment negative for DI cans for a c cut are also large, there is still no surface treatment negative which can be equal to the outstanding necked-in nature and the further gage down.

[0005] In order to make DI can as a metal vessel which was [ like ] more excellent described above, there is no surfa treatment negative for DI cans which still had sufficient property. From such a situation, the surface treatment negati row for DI cans excellent in a pressure resistance and necked-in nature is expected offer of the manufacture method strongly.

[0006]

[Problem(s) to be Solved by the Invention] The technical problem which this invention tends to solve from such the present condition is providing with the manufacture method the surface treatment negative row for DI cans excellent the outstanding pressure resistance which can be equal also to the further gage down, and necked-in nature.

[0007]

[Means for Solving the Problem] In order that this invention person etc. might solve the above-mentioned technical

problem, some of the achievement meanses [ various ] examined about \*\* whether there might be any steel plate property that the outstanding pressure resistance which can be equal also to the further gage down of DI can, and the outstanding necked-in nature may be reconciled again. The surface treatment negative for DI cans excellent in the pressure resistance which is compatible as a result, and necked-in nature, and its manufacture method were found out for the first time.

[0008] That is, the summary of this invention is as follows.

By weight %, (1) C:0.0005 - 0.0700%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminum: 0.0 0.100%, N: $\leq$ 0.0100%, B Both :0-(0.0010+1.8xN %) %, and Nb and Ti : [ both / either or ] / 0 - 0.050%, It consists a remainder unescapable impurity and iron, and Y.P (3%BH) is 2 39 kgf(s)/mm. Y.P (50%BH) is 2 62 kgf(s)/mm above. Surface treatment negative for DI cans excellent in the pressure resistance characterized by being the following and necked-in nature.

[0009] By weight %, (2) C:0.0005 - 0.0700%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminum 0.002-0.100%, N: $\leq$ 0.0100%, It consists of a remainder unescapable impurity and iron 0 to 0.050%. G.Sno B: Both (0.0010+1.8xN %) %, and Nb and Ti : or more by 9.0 [ both / either or ] Y. P (3%BH) is 2 39 kgf(s)/mm. Y.P (50% BH) is 2 62 kgf(s)/mm above. Surface treatment negative for DI cans excellent in the good pressure resistance and necked-in nature of the flange processability characterized by being the following.

[0010] By weight %, (3) C:0.0005 - 0.0060%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminum 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.03%, [ both / either or ] Hot-rolled and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -830 degree C by the continuous-annealing method. It cools to a room temperature and is 5 ppm about the amount of dissolution C in a steel plate. After considering as the following, temper rolling gives distortion of 40% or less 10% more. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> It is Y.P (50%BH) 62 kgf(s)/mm above 2 The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting t below, and necked-in nature.

[0011] By weight %, (4) C:0.0020 - 0.0045%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminum 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.01%, [ both / either or ] Hot-rolled and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -830 degree C by the continuous-annealing method. It cools to a room temperature and is 5 ppm - 30 ppm about the amount of dissolution C in a steel plate. You make it remain. Then, temper rolling gives distortion of 30% or less 5% more by the pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Above, Y. The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting P (50%BH) to two or less [ 62 kgf(s)/mm ], and necked-in nature.

[0012] (5) Preceding clause (3) Or (4) It is the manufacture method of the surface treatment negative for DI cans excellent in the good pressure resistance of the flange processability beyond G.Sno:9.0 characterized by hot-rolling in the method of a publication by finishing 890 degrees C or more above 900 degrees C preferably at the time of hot rolling, and considering as a hot-rolling steel strip, and necked-in nature.

[0013] By weight %, (6) C:0.0005 - 0.0700%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminum 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.050%, [ both / either or ] Hot-rolled and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -750 degree C by the box annealing method. Cool to a room temperature and temper rolling gives distortion of 40% less 10% or more by the pace of expansion after that. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> It is Y.P (50% BH) 62 kgf(s)/mm above 2 The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below, and necked-in nature.

[0014] By weight %, (7) C:0.0005 - 0.0060%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminum 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.050%, [ both / either or ] Hot-rolled and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. faces cold-rolling at 85 - 95% of rate of cold rolling, and carrying out recrystallization annealing after that. Temperature region at least 500 degrees C or more is heated at recrystallizing-temperature -920 degree C by the 100 2500 degrees C [ /s ] heating rate. Carry out 0-10sec stay in the temperature region, perform recrystallization annealing

and it cools to a room temperature. Then, temper rolling gives distortion of 40% or less 5% or more by the pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup> The manufacture method of the surface treatment negative for DI cans excellent in the good pressure resistance of the flange processability beyond G.Sno:9.0 characterized by adjusting to below, and necked-in nature.

[0015] this invention is described in detail below. It was called for that this invention person etc. maintains high intensity by one side first, it examined that there might be a steel plate property that the pressure resistance which the thing which were referred to as that it is called for that it is elasticity more on the other side, and to conflict excelled DI can demanded, and the outstanding necked-in nature may be reconciled, and found out that there was the possibil Below, the view which may be reconciled is explained.

[0016] First, it examined raising necked-in nature. In order to raise the necked-in nature of DI can, the method of lowering the deformation resistance of the necked-in section at the time of necked-in processing happens to think easily. First, although this invention person etc. investigated the applicability of the plating negative for DI cans by t box annealing method applied conventionally as a method of reducing the intensity of the plating negative before DI processing, a result said that a pressure resistance cannot secure at all was brought, and he checked anew that it was inapplicable with the elasticity former plating negative for DI cans.

[0017] Then, possibility of a steel plate that the pressure resistance which was excellent in DI can, and the outstanding necked-in nature might be reconciled was examined. Although it was just like that that the thing which were referred as that it is called for that surely intensity high at one side is called for, and the steel plate property that the pressure resistance which was excellent in this DI can, and the outstanding necked-in nature may be reconciled is elasticity m on the other side and to conflict was required, this invention person etc. examined that the pressure resistance of DI c and the intensity of the necked-in section were really what things. As conventionally shown also in the results of an investigation of the elasticity former [ above-mentioned ] plating negative for DI cans, the pressure resistance of DI c and the intensity of the necked-in section are proportional to the intensity of a negative, and if negative intensity is high, they will both become high. Therefore, it was thought that the improvement in the necked-in nature by lightweight-izing by on-the-strength elevation of a steel plate and elasticity-izing of a steel plate could be easily incompatible.

[0018] As a result of this invention person's etc. examining many things, the pressure resistance of DI can is the deformation resistance of the steel plate of the bottom section of DI can with which baking finish of back BH heat treatment by which DI processing was carried out was performed, and the deformation resistance is a deformation resistance of the part to which back (several% of processing distortion) BH heat treatment with which dome processi of the bottom section was performed was performed. the contraction ratio of {sum total to which, as for the intensity the necked-in section, three ironing (ironing) processings were given after two draw forming on the other hand -- the drawing distortion and board thickness distortion of about 2.0 -- about 40%(equivalent to about 67% by pace of expansion)} -- processing to which BH heat treatment was performed further the back -- it is the deformation resistan of a very high distorted part Therefore, if there is a big difference that both intensity of these both differs in the deformation amount of beforehand both deformation greatly although it is the same in respect of the deformation resistance after BH heat treatment after deformation was performed beforehand and not the not necessarily same thin but the property of steel is fully utilized, the weighted solidity will notice it being the factor which can be changed respectively independently, will conduct various experiments, and will find out the steel of this invention. It is an ide that the deformation resistance after BH heat treatment after several% of processing is more high and the deformatio resistance after BH heat treatment after about 40% of processing should just specifically be low steel more in board thickness distortion.

[0019] First, this invention person etc. performed examination for clarifying a target quality-of-the-material index us the steel variously made as an experiment in the pressure resistance of DI can, necked-in nature, and the conventiona T-4CA row based on this idea. As a result of making as an experiment and examining various steel plates, the pressu resistance of DI can and the intensity of the necked-in section found out that it could represent with Y.P (3%BH) and Y.P (50%BH) of a steel plate. in addition, the intensity of the necked-in section of DI can, although it is desirable to evaluate the deformation resistance after giving the very high distortion by about 40% (a pace of expansion 67%) by board thickness distortion originally \*\* As a result of investigating about various steel plates, it has by the deformati resistance at the time of 50% by the pace of expansion, and substitution of the measured value of the deformation resistance of 40% of board thickness distortion is fully possible, \*\* Measurement of the deformation resistance (yel stress by JIS-#5 test piece) after no less than 40% of high distortion was given by board thickness distortion Since



variation arose in measured value that it is easy to be influenced of the process tolerance of the piece of a tensile test etc., it had the intensity of the necked-in section by Y.P (50%BH) of a steel plate, and it was made into the index val

[0020] Next, the conditions which reconcile the pressure resistance which was excellent in DI can, and the outstanding necked-in nature were examined. T-4CA for DI cans for which drawing 1 has so far been used for lightweight-izing, The steel plate which made Y.P of a negative high by adding P and Mn based on the aluminum-K steel of box annealing (BAF) currently used before, The steel plate which made Y.P of a negative high by changing C content an annealing conditions based on super-low carbon aluminum-K steel, and making the dissolution C in a steel plate increase, The steel plate which made Y.P of a negative high for Nb addition super-low carbon steel with the rate of temper rolling high at the base (it is described as Following HRT), While it is alike, attaching, building a negative w 0.220mm which is the board thickness at the time of a gage down and investigating the relation between Y.P of a negative, Y.P (3%BH), and Y.P (50%BH), it is drawing in which having performed tinning, having built DI can, having investigated a pressure resistance and necked-in nature, and having shown the result. For drawing 1 to pressu resistance, Y.P (3%BH) is 2 39 kgf(s)/mm. Pressure resistance can be secured above also at the time of a gage down and Y.P (50%BH) is 2 62 kgf(s)/mm about wrinkling generating at the time of necked-in one. It turns out that generating of a wrinkling is also lost below, and it turns out well that the surface treatment negative of this invention a negative for DI cans which has the outstanding pressure resistance and necked-in nature.

[0021] Furthermore, the point which should be noted is also understood that there are two points from the result of drawing 1 . The 1st point is about necked-in nature, and even if Y.P of a negative is high, while necked-in nature has good thing, even if Y.P of a negative is low, the thing of inferior necked-in nature is also a certain point. That is, it is the point which was able to show clearly that necked-in nature cannot be judged at all, but can be judged with the va of Y.P (50%BH) of the evaluation method of this invention from Y.P of a negative by this invention person's etc. investigation for the first time. The 2nd point adjusts C content to the steel plate and super-low carbon aluminum-K steel which P and Mn were added [ steel ] to BAF-aluminum-K steel, and only raised Y.P of a negative, as shown in drawing 1 . in the negative of only making the amount of dissolution C increase Although there is no range with whi necked-in nature and a pressure resistance are compatible, the steel plate Y. [ of a negative ] made high by HRT base on Nb addition super-low carbon steel is the point that it became clear that there is a compatible range, under a certai conditions.

[0022] As mentioned above, "Y. equipped with the main points of this invention as explained to the drawing 1 row above P (3%BH) More than 39 kgf(s)/mm<sup>2</sup> Y. surface treatment negative" for DI cans to which P (50%BH) is characterized by 62 kgf(s)/mm being two or less It is the outstanding plating negative for DI cans which becomes compatible with having reservation of the outstanding pressure resistance which can be borne also at the time of a ga down, and the outstanding necked-in nature, and it turns out that industrial value is very high.

[0023] Next, the steel plate which this invention person etc. made [ Y. / of a negative ] high by HRT based on Nb addition super-low carbon steel of drawing 1 examined the optimum conditions further under a certain conditions paying attention to there being a range with which a pressure resistance and necked-in nature are compatible. As a result, it is a claim (3). After making the 5 ppm of the amounts of dissolution C in a steel plate into the following, Temper rolling gives distortion of 40% or less 10% or more by the pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup> The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below and necked-in nature" is found out.

[0024] Moreover, the steel plate which made Y.P of a negative high by changing C content and annealing conditions based on the super-low carbon aluminum-K steel of drawing 1 , and making the dissolution C in a steel plate increas Paying attention to being effective in improving necked-in nature, further, the optimum conditions are examined and is a claim (4). by making 5 ppm - the 30 ppm of the amounts of dissolution C in a steel plate remain 30% of distortio is given 5% or more by the pace of expansion which made it possible to reduce the required rate of temper rolling. It Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> It is Y.P (50%BH) 62 kgf(s)/mm above 2 The method of the manufactu method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting t below and necked-in nature" is found out.

[0025] In addition, in order for the use to which severe flange processing is carried out especially to be also in DI can and to apply to such a use, the more excellent flange processability is required. Then, this invention person etc. examined the steel plate property of being able to be equal also to such severe flange processing. First, it is the claim

(3) of this invention about HRT which is one condition of a meta-RAJI means to attain this invention. (4) Although in the manufacturing method of a steel plate when the purpose differs both from a field of the invention The manufacture conditions (manufacture conditions of the example of this official report) of the steel plate indicated by "JP,1-52451, currently indicated as a manufacturing method of the steel plate which a mere stretcher strain does not generate" of the manufacture method of giving HRT to reference A component, annealing, and the rate of temper rolling were changed many things were adjusted and it inquired so that it might become the weighted solidity of this invention steel plate, and flange processability was investigated. However, the result that there were some which run short of flange processability was brought. Then, although there is correlation remarkable between the diameter of crystal grain of an annealing board and flange processability, and flange processability is improved so that the diameter of crystal grain small as a result of examining many things about the weighted solidity of a steel plate, and the relation of flange processability, in order to investigate the cause In the above-mentioned test coupon according to the manufacturing method of the example of the above-mentioned official report, since it was about 8.5 boards which have G.Sno [ fine grain seven to about 8.5 ], for acquiring, for acquiring sufficient flange processability, the diameter of crystal grain was too large, and it became clear that it is necessary to improve further.

[0026] As a result of this invention person's etc. examining how to carry out grain refining of the diameter of crystal grain of an annealing board, it turns out that influence with the big finishing temperature at the time of hot-rolling is done, it is making finishing temperature into 890 degrees C or more, G.Sno becomes 9.0 or more by the crystal grain a hot-rolling board carrying out grain refining notably, and sufficient flange processability can also be secured. Furthermore, by making finishing temperature into 900 degrees C or more, G.Sno becomes 9.5 or more, and it also turns out that the more excellent flange processability is securable, and is a claim (2). A steel plate and claim (5) The method was able to be found out.

[0027] Claim (6) Claim (3) After making the 5 ppm of the amounts of dissolution C in a steel plate into the following Temper rolling gives distortion of 40% or less 10% or more, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup> About the method of adjusting to below" The amount of dissolution C in steel plate is 5 ppm about this. How to apply to the box annealing method which becomes the following is examined "Are performed C:0.0005 - 0.0700% of aluminum-K steel by the box annealing method, and recrystallization anneal is performed at recrystallizing-temperature -750 degree C. Cool to a room temperature and temper rolling gives distortion of 40% or less 10% or more by the pace of expansion after that. It is Y.P (3%BH) of a steel plate 39 kgf (s)/mm<sup>2</sup> It is Y.P (50%BH) 62 kgf(s)/mm<sup>2</sup> above 2 The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below and necked-in nature" is found out.

[0028] Furthermore, this invention person etc. is a claim (5) to which the diameter of crystal grain makes G.Sno 9.0 more in the super-low carbon steel which is easy to become large. The option was also examined, temperature region least 500 degrees C or more was heated in s in 100-2500 degrees C /at the time of continuous annealing of a claim (3) and the method of carrying out recrystallization annealing which performs \*\*\*\* for 5 or less seconds at recrystallizing temperature -920 degree C was found out. By this method, it was not based on the finishing temperature of hot-rolling but it became possible to make G.Sno of a steel plate or more into 9.5 further nine or more, and it also turns out that good flange processability is also securable.

[0029] The composition conditions of a steel plate are described in detail below. C needs to regulate a maximum value individually according to the manufacture conditions of each claim. Claim (1) (2) Since the amount of cementites of negative [ super-\*\*\*\*\* and ] of any manufacture conditions in a steel plate increased too much 0.0700% then and it became impossible to have secured flange processability and necked-in nature, the upper limit was made into 0.0700 Claim (3) It is 5 ppm about the amount of dissolution C in the steel plate after 0.0060% super-\*\*\*\*\* and continuous annealing. Since a lot of Nb(s), Ti, etc. had to be added, a lot of Nb(s) and Ti caused the rise of a recrystallizing temperature and it came to have exceeded 830 degrees C which can be annealed by the usual continuous-annealing method in order to have made it below, the upper limit was made into 0.0060%. Claim (4) It is 30 ppm about the amount of dissolution C in 0.0045% super-\*\*\*\*\* and a steel plate. Since it became impossible to have made it below the upper limit was made into 0.0045%. Claim (6) Claim (1) The upper limit was made into 0.0700% by the same reason.

[0030] Claim (7) It is 5 ppm about the amount of dissolution C in the steel plate after 0.0060% super-\*\*\*\*\* and continuous annealing. Since, as for a lot of Nb(s) and Ti, alloy cost became high too much by having to add a lot of Nb (s), Ti, etc. in order to have made it below, the upper limit was made into 0.0060%. In addition, since less than 0.0005% of thing could not build 0.0005% or more of a lower limit with the usual manufacturing method, it made the

lower limit 0.0005%.

[0031] Each of Si, Mn, P, and S is the elements which affect the corrosion resistance of a steel plate greatly, and is  $\leq 0.30\%$ ,  $\leq 1.00\%$ ,  $\leq 0.30\%$ , and  $\leq 0.25\%$  from a corrosion resistance viewpoint, respectively. In addition, from a viewpoint of the ear dry-area nature at the time of hot-rolling, since Mn needed to be contained at least 0.05% or more it made the lower limit 0.05%. Since other Si, P, and S did not have an obstacle and a bird clapper at least, they did not regulate a lower limit.

[0032] sol.aluminum was used as a deoxidizer, and 0.002%, since it remained, the lower limit was made into 0.002%. Moreover, air oxidation of molten steel becomes easy to happen at the time of 0.100% super-\*\*\*\*\*, and casting, the amount of inclusion increased, and since it also came to have degraded processability and plating quality, 0.100% was made into the upper limit.

[0033] Since grain refining of crystal grain became remarkable and press-working-of-sheet-metal nature deteriorated when super-contained 0.0100%, N made the upper limit 0.0100%. In addition, however N may decrease, especially since it does not have a bad influence on the quality of the material, it is not necessary to regulate it.

[0034] What is necessary is just to add B suitably to fix N as BN and elasticity-ize a steel plate. Since hard-ization according [ B content ] to solid solution strengthening of  $0.0010+1.8 \times N$  % super-\*\*\*\*\*, and B became remarkable, the upper limit was made into  $0.0010+1.8 \times N$  %.

[0035] Although what is necessary is just to have added when the diameter of crystal grain of a higher r value or an annealing board is made into a fine grain, or lower Y.P (50%BH) was obtained as shown also in drawing 1, and necked-in nature wants to have improved further, since alloy cost just became [ Nb, Ti, or Nb+Ti ] high also in 0.050% super-\*\*\*\*\* and the improvement effect of the quality of the material came to be saturated, Nb and Ti made the upper limit 0.050%. Claim (3) In the case, since 0.030% super-\*\*\*\*\*, and the recrystallizing temperature at the time of continuous annealing came to have exceeded 830 degrees C, Nb, Ti, or Nb+Ti made the upper limit 0.030%. Claim (4) A case is 5 ppm about the required amount of dissolution C, if Nb, Ti, or Nb+Ti exceeds 0.010%. Since it became impossible to have made it remain above, the upper limit was made into 0.010%. Claim (6) (7) Since the improvement effect of the quality of the material came to be saturated with about [ that alloy cost becomes / Nb, Ti, or Nb+Ti / high 0.050% also in super-\*\*\*\*\* ], the case also made the upper limit 0.050%.

[0036] In order to reconcile the outstanding necked-in nature with the outstanding pressure resistance as a quality-of-the-material index of a steel plate As mentioned above, since "it is Y.P (50%BH) more than 39 kgf(s)/mm<sup>2</sup> about Y. (3%BH) of a steel plate Below 62 kgf(s)/mm<sup>2</sup>" is indispensable It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Y.P (50%BH) was regulated or less [ 62 kgf(s)/mm ] to two above.

[0037] The amount of dissolution C is one of the points of this invention, and is a claim (4). By the method As shown in drawing 1, it is Y.P (50%BH) 62 kgf(s)/mm<sup>2</sup> 34kgf/mm<sup>2</sup> [ required to be the following and secure a pressure resistance ] Maintenance of Y.P (3%BH) Rationalization of the amount of dissolution C is also important, and it is 5 ppm. Since reservation of the pressure resistance excellent in less than 10% of rate of temper rolling becomes difficult in the following, it is 5 ppm about a lower limit. It carried out. moreover, the amount of dissolution C -- 30 ppm since reservation of the necked-in nature which was excellent even if it made combination of super-\*\*\*\*\* and HRT into optimal conditions, and the outstanding necked-in nature becomes difficult -- a upper limit -- 30 ppm \*\* -- it carried in addition, claim (3) a method -- the upper limit of the amount of dissolution C in a steel plate -- 5 ppm having considered as the following -- the amount of dissolution C in a steel plate -- 5 ppm super-\*\*\*s -- \*\*\*\* -- claim (4) in which lower temper rolling is possible since it becomes advantageous economically to apply a method -- this -- claim (3) It writes that it is out of range, and comes out.

[0038] Hereafter, manufacture conditions other than the component composition condition of a steel plate are described in detail. If it is the method by which the component of the steel of each claim is obtained, what method is sufficient the manufacture conditions of a cast piece, and it is not necessary to regulate them especially. The method of carrying out rolling between post heating which inserted the piece of heat in the heating furnace also by the method of hot-rolling directly the piece of heat which it is not necessary to regulate especially, and the usual hot-rolling conditions sufficient as, and was manufactured by the continuous casting for energy saving is sufficient also as hot-rolling conditions. Moreover, although it is not necessary to also regulate especially rolling-up temperature, when it is going to obtain elasticity material, it is good to adopt inside elevated-temperature rolling up. In addition, it is a claim (5) when acquiring the more excellent flange processability. 900 degrees C or more 890 degrees C or more are preferably good in finishing temperature so that it may regulate.

[0039] Since the rate of cold rolling influences the earing of DI can greatly, it is necessary to make it into 85 - 95%.

addition, in order to obtain the rate of an earring near zero, it is desirable to tune finely in consideration of the component of steel, hot-rolling conditions, and annealing conditions.

[0040] Recrystallization annealing conditions are a claim (3) although it changes greatly with annealing methods. What is necessary is to perform recrystallization annealing at recrystallizing-temperature -830 degree C, and just to carry out cooling to a room temperature after that by the usual continuous-annealing method [ like ]. In addition, the annealing temperature was made into 830 degrees C or less because 830-degree-C super-\*\*\*\*\* and a steel plate became soft, troubles, such as being prolonged during plate leaping, occurred and annealing became impossible. on the other hand claim (7) also call it an annealing machine like [ it is quick 2 figures at the heating rate of the method of annealing, and ] a completely different machine from the conventional continuous annealing furnace short about 2 figures in annealing time -- \*\* -- in the new annealing facility, since it was [ that what is necessary is for the limit from plate-leaping nature not to have the upper limit of an annealing temperature, and just to determine from the quality of the material ] permissible to the temperature which does not go into an austenite, the upper limit was made into more than [ moreover, / heating temperature region at least 500 degrees C or more by the heating rate 100 degrees C //s / or more in order to acquire the grain-refining effect of the diameter of crystal grain of an annealing board and more than a recrystallizing temperature ] -- the residence time in a temperature region 920 degrees C or less -- 10sec(s) There is a need of considering as the following. In addition, in the heating rate beyond it, since the heating rate was too quick a control of heating terminal point temperature became difficult, having carried out the upper limit of a heating rate in 2500 degrees C/s carried out the upper limit in 2500 degrees C/s.

[0041] Temper rolling is an important element in composition of a steel plate, and adjustment of the amount of dissolution C, in order to make it "being Y.P (50%BH) more than 39 kgf(s)/mm<sup>2</sup> about Y.P (3%BH) of a steel plate Below 62 kgf(s)/mm<sup>2</sup>". [ which is one of the important points of the steel plate of this invention ] Claim (3), As shown in (6), the amount of dissolution C of a steel plate is 5 ppm. Since reservation of "being Y.P (3%BH) of a steel plate More than 39 kgf(s)/mm<sup>2</sup>" for the rate of temper rolling securing a pressure resistance at less than 10% when it is the following became impossible, the lower limit was made into 10%. In addition, that it is easy to generate a crack at the time of the spinning at the time of DI processing, with the bird clapper, since the economical loss increased in coming out enough at 40% for maintaining the pressure resistance of the present condition level which the steel plate of this invention makes the purpose, and giving a certain thing and the further more high rate of temper rolling, having made the upper limit into 40% made the upper limit 40% again. Claim (7) A upper limit is also the same reason. Claim (4) The amount of dissolution C of a steel plate is 30 ppm. Since the rate of temper rolling became impossible at less than 5.0% as for reservation of "being Y.P (3%BH) of a steel plate More than 39 kgf(s)/mm<sup>2</sup>" even if it made [ many / to below ] it, the lower limit was made into 5.0%. In addition, for having made the upper limit into 30%, Dissolution C 5-30 ppm. Since it contained mostly and reservation of flange processability became difficult at the rate of temper rolling of \*\* 30%, the upper limit was made into 30%.

[0042]

[Example] It is a book below. The 0.220mm surface treatment negative which is the board thickness at the time of a gage down was manufactured to Table 1 in a component and Table 2 on continuation hot-rolling, cold rolling, continuous annealing, temper rolling, and conditions. The amount of dissolution C of the manufactured surface treatment negative, Y.P (3%BH), and Y.P (50%BH) were measured. Moreover, DI performance after Sn plating was investigated. The result is shown in Table 3.

[0043] Steel A, B, C, D, E, and F is all the steel of component within the limits of this invention. Steel A The example and Steel B with which the amount of C added Nb 0.006% at 0.0025% As for the example which added Ti 0.025%, Steel C, 0.007%, the example which added B 0.0008%, and Steel D Nb Even if C makes it fall extremely with 0.001 and does not add Nb and Ti, the amount of dissolution C after annealing is 5 ppm. The example and Steel E which become the following are a claim (1). Although it is within the limits of (2) claim (4) if there are too many C content on manufacture conditions -- the example of comparison -- becoming -- namely, C content -- 0.0055% -- many -- the dissolution C content after annealing -- 35 ppm the example and Steel F which became -- C content -- the example of content of 0.0410% and the usual low carbon aluminum-K steel -- it comes out

[0044] The steel with which, as for steel 1 and 2, the amount of C added Nb 0.006% at 0.0025% in samples 1, 2, 8, 9 and 10, As for the steel with which steel 8 added Ti 0.025%, and steel 9, 0.007%, the steel which added B 0.0008%, and steel 10 Nb Even if C makes it fall extremely with 0.0011% and does not add Nb and Ti, the amount of dissolution C after annealing is 5 ppm. The steel made into the following is used. All are the claims (3) of this invention. (4) Or It is an example. this invention carried out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-o

the-material index, board thickness secured the pressure resistance at the time of 0.220mm and the further gage down and the outstanding necked-in nature was obtained. Moreover, separately, as a result of evaluating flange processability, it is a claim (5). As for the samples 2, 8, 9, and 10 of an example, flange processability with crystal grain good at a fine grain was acquired by each.

[0045] For samples 3 and 4, a sample 2 and the rate of temper rolling are the claim (5) of 7.0%, 1.0%, and this invention. Y.P (3%BH) of the target quality-of-the-material [ are an example of comparison and / this invention ]-all index which separated from the range of the rate of temper rolling is 2 34.26 kgf(s)/mm. It separated low and the pressure resistance at the time of a gage down has not been secured. The steel with which the amount of C added Nb 0.006% at 0.0025% is used for a sample 5, and it is the claim (6) of this invention. It is the example applied to the box annealing method, and the invention in this application carries out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, the pressure resistance at the time of a gage down is secured, and the outstanding necked-in nature is obtained.

[0046] For a sample 6, the rate of temper rolling is the claim (6) of 1.0% and this invention. Y.P (3%BH) of the target quality-of-the-material [ are an example of comparison and / this invention ] index which separated from the range of the rate of temper rolling is 2 25 kgf(s)/mm. It separates low and the pressure resistance cannot be secured. The steel with which the amount of C added Nb 0.006% at 0.0025% is used for a sample 7, and it is the claim (7) of this invention. It is the example applied to the super-rapid heating short-time annealing method, and this invention carries out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, the pressure resistance at the time of a gage down is secured, and the outstanding necked-in nature is obtained. Moreover, as a result of evaluating flange processability, the flange processability which G.Sno is 10.6 with the fine grain notably, and was excellent was acquired.

[0047] A sample 11 is a claim (1). Although it is within the limits of (2) Claim (4) On manufacture conditions, C content is the example of comparison which are, namely, there are many C contents as 0.0055%, and the dissolution content after annealing is 35 ppm. It is the example of comparison which became. Y.P (50%BH) of a target quality-of-the-material [ this invention ] index is 2 65 kgf(s)/mm. It separates highly and the outstanding necked-in nature cannot be secured. 0.041% and the usual low carbon aluminum-K steel are used for a sample 12 for C content, and it is the claim (6) of this invention. It is the example applied to the box annealing method, and this invention carries out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, a pressure resistance is secured and the outstanding necked-in nature is obtained.

[0048] For a sample 13, a sample 12 and the rate of temper rolling are the claim (6) of 1.0% and this invention. Y.P (3%BH) of the target quality-of-the-material [ are an example of comparison and / this invention ] index which separated from the range of the rate of temper rolling is 2 26 kgf(s)/mm. It separates low and the pressure resistance at the time of a gage down cannot be secured. For a sample 14, Y.P (50%BH) of a target quality-of-the-material [ are the conventional example of T-4CA for the conventional DI cans, and / this invention ] index is 2 66 kgf(s)/mm. It separates highly and the wrinkling has occurred at the time of necked-in one. [0049] clear from the result of the above example -- as -- "Y. of the main points of the steel plate of this invention -- P (3%BH) more than 39 kgf(s)/mm<sup>2</sup> Y. P (50%BH) is 2 62 kgf(s)/mm. The surface treatment negative for DI cans characterized by being the following" That industrial value is very high at the plating negative for DI cans which has outstanding DI can processability which becomes compatible and the claim (3) of having reservation of the pressure resistance at the time of a gage down, and the outstanding necked-in nature - (7) It turns out that it can manufacture by the manufacture method.

[0050]

[Table 1]

鋼	成 分 分 分 (%)								備 考
	C	Mn	P	S	sol. Al	N	B	Nb	Ti
A	0.0025	0.10	0.010	0.006	0.043	0.0018	T r	0.006	T r
B	0.0020	0.11	0.009	0.012	0.053	0.0016	T r	T r	0.025
C	0.0024	0.10	0.011	0.007	0.044	0.0018	0.008	0.007	T r
D	0.0011	0.10	0.012	0.008	0.050	0.0019	T r	T r	T r
E	0.0055	0.20	0.015	0.010	0.043	0.0020	T r	T r	T r
F	0.0410	0.25	0.012	0.008	0.055	0.0014	T r	T r	T r

[0051]  
[Table 2]

試料	供試鋼	熱延		連統焼鈍			調圧 (%)	備考		
		F. T		方式	H. R (°C/s)	S. T×t (°C)(sec)				
		SRT (°C)	C. T (°C)							
1	A	1150	860	650	CAL	20	770×20.0s	0	20.0	請求項(3), (4)
2	A	1150	925	650	CAL	20	770×20.0s	0	20.0	請求項(5)
3	A	1150	925	650	CAL	20	770×20.0s	0	7.0	比較例
4	A	1150	925	650	CAL	20	770×20.0s	0	1.0	比較例
5	A	1150	925	650	BAF		660×15Hr		20.0	請求項(6)
6	A	1150	925	650	BAF		660×15Hr		1.0	比較例
7	A	1150	925	650	N-CAL	1000	800×0.3	0	20.0	請求項(7)
8	B	1200	925	650	CAL	20	750×20.0s	0	15.0	請求項(5)
9	C	1200	925	650	CAL	20	750×20.0s	0	15.0	請求項(5)
10	D	1100	925	580	CAL	20	650×20.0s	0	20.0	請求項(5)
11	E	1100	925	620	CAL	20	660×20.0s	0	15.0	比較例
12	F	1240	880	550	BAF		640×5Hr		15.0	請求項(6)
13	F	1240	880	550	BAF		640×5Hr		1.0	比較例
14	F	1200	880	550	CAL	20	640×20.0s	0	1.0	従来例

但し、SRT：スラブ加熱温度、F. T：熱延仕上温度、C. T：巻き取り温度

H. R：加熱速度、S. T：均熱温度、t 1：均熱時間、t 0 A：450 °Cでの過時効処理時間

CAL：通常の連続焼鈍法、N-CAL：請求項(7)のような超急速加熱短時間焼鈍法

試料	評価結果					備考
	固溶C (ppm)	Y. P (3%BH) (kgf/mm <sup>2</sup> )	Y. P (50%BH) (kgf/mm <sup>2</sup> )	D I 性能		
				耐圧強度	ネックドイン性	
1	1	44	57	○	○	請求項(3), (4)
2	1	45	57	○	○	請求項(5)
3	1	34	53	×	○	比較例
4	1	26	52	×	○	比較例
5	0	44	56	○	○	請求項(6)
6	0	25	52	×	○	比較例
7	1	45	57	○	○	請求項(7)
8	1	41	55	○	○	請求項(5)
9	1	42	55	○	○	請求項(5)
10	3	44	56	○	○	請求項(5)
11	35	47	65	○	×	比較例
12	0	41	55	○	○	請求項(6)
13	0	26	53	×	○	比較例
14	45	44	66	○	×	従来例

耐圧強度 : ボトム部の耐圧強度の評価 (○ : 合格、× : 不足)

ネックドイン性 : ネックドイン性の評価 (○ : 合格、× : しわ発し)

[0053]

[Effect of the Invention] Although this invention was explained above in detail The effect which excelled [ steel plat of this invention ] in a pressure resistance and necked-in nature, it was applied to DI can of severer fabrication, and w excellent can be demonstrated. Claim in the usual continuous-annealing facility (3), (4), (5) Claim in a method and th box annealing method (6) Claim in a continuous-annealing method very compact in a row (7) It is a method, and it becomes possible to manufacture the steel plate of this invention, and the industrial value is size.



[Translation done.]

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TECHNICAL FIELD

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[Industrial Application] In the surface treatment negative for DI cans with which tinning is performed, this invention relates to the surface treatment negative for DI cans and the manufacture method excellent in the pressure resistance and necked-in nature of DI can which can secure a predetermined pressure resistance, when the gage down of the bottom thickness of the black plates for DI cans is carried out (it is the gage down to 0.245mm to 0.220mm of the present condition about the present board thickness).

[0002] In addition, the abbreviation used on these specifications has the following meaning.

G. Sno : the grain-size-number number of a negative.

Y. -- P(3%BH): -- Y.PY.P(50%BH): after performing after [ an additional rolling prestrain ] BH heat treatment of 3% of paces of expansion -- 50% of paces of expansion Y.PBH heat treatment after performing after [ an additional rolling prestrain ] BH heat treatment: 200 degree-Cx10min Heat treatment.

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[Translation done.]

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PRIOR ART

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[Description of the Prior Art] The surface treatment negative for DI cans with which tinning is performed is set in the past. the aluminum killed (aluminum-K) steel of the homaxial grain which improved the earing nature manufactured by the box annealing method as shown in JP,61-243124,A and JP,53-123644,A -- the aluminum-K steel of a certain extension grain was applied for many years, and the degree of temper was the steel plate of non-aging in the elasticity of one to 2 (it is described as T-2 the following T-1) grade. Then, the board thickness of a steel plate was decreased a lightweight-ization of DI can was advanced. In order to compensate the shortage of a pressure resistance to the internal pressure of the bottom section of DI can in performing this lightweight-ization, it has been changed and applied to the steel plate with BH nature by hard [ which is called T-4CA which manufactures the aluminum-K steel currently manufactured from the former by continuous annealing ].

[0004] recently, while progress with the much more lightweight-izing of DI can is desired, for the cost cut of aluminum (aluminum) board used for a can top, minor diameter-ization is performed and multi-stage necked-in processing gives the path of the top section (necked-in section) of DI can -- having -- coming -- just -- being alike -- four-step necked-in processing began to be adopted. However, although T-4CA currently supplied as a present material for DI cans is enough as the pressure resistance of a can, four-step necked-in processing to which the rate of necked-in one becomes severer at the time of minor-diameter [ as / whose path of a can top is  $204\phi$ , i.e.,  $(2+4/16)\phi$  inch, for example ]-izing must be performed, there is a problem that a wrinkling occurs, and it is in the situation that progress has stagnated. On the other hand, although the needs of a gage down of the surface treatment negative for DI cans for a cut are also large, there is still no surface treatment negative which can be equal to the outstanding necked-in nature and the further gage down.

[0005] In order to make DI can as a metal vessel which was [ like ] more excellent described above, there is no surface treatment negative for DI cans which still had sufficient property. From such a situation, the surface treatment negative for DI cans excellent in a pressure resistance and necked-in nature is expected offer of the manufacture method strongly.

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[Translation done.]

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] Although this invention was explained above in detail, it is the steel plate of this invention. The effect which is excellent in a pressure resistance and necked-in nature, was applied to DI can of severer fabricati and is excellent can demonstrate, and it is a claim (3) in the usual continuous-annealing facility. (4) (5) The claim (6) a method and the box annealing method The claim (7) in a continuous-annealing method very compact in a row It is method, and it becomes possible to manufacture the steel plate of this invention, and the industrial value is size.

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[Translation done.]

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] The technical problem which this invention tends to solve from such the present condition is providing with the manufacture method the surface treatment negative row for DI cans excellent the outstanding pressure resistance which can be equal also to the further gage down, and necked-in nature.

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[Translation done.]

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## MEANS

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[Means for Solving the Problem] In order that this invention person etc. might solve the above-mentioned technical problem, some of the achievement meanses [ various ] examined about \*\* whether there might be any steel plate property that the outstanding pressure resistance which can be equal also to the further gage down of DI can, and the outstanding necked-in nature may be reconciled again. The surface treatment negative for DI cans excellent in the pressure resistance which is compatible as a result, and necked-in nature, and its manufacture method were found ou for the first time.

[0008] That is, the summary of this invention is as follows.

By weight %, (1) C:0.0005 - 0.0700%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminu 0.0 0.100%, N: $\leq$ 0.0100%, B Both :0-(0.0010+1.8xN %) %, and Nb and Ti : [ both / either or ] / 0 - 0.050%, It consists a remainder unescapable impurity and iron, and Y.P (3%BH) is 2 39 kgf(s)/mm. Y.P (50%BH) is 2 62 kgf(s)/mm above. Surface treatment negative for DI cans excellent in the pressure resistance characterized by being the followin and necked-in nature.

[0009] By weight %, (2) C:0.0005 - 0.0700%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminu 0.002-0.100%, N: $\leq$ 0.0100%, It consists of a remainder unescapable impurity and iron 0 to 0.050%. G.Sno B: Both (0.0010+1.8xN %) %, and Nb and Ti : or more by 9.0 [ both / either or ] Y. P (3%BH) is 2 39 kgf(s)/mm. Y.P (50% BH) is 2 62 kgf(s)/mm above. Surface treatment negative for DI cans excellent in the good pressure resistance and necked-in nature of the flange processability characterized by being the following.

[0010] By weight %, (3) C:0.0005 - 0.0060%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminu 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.03%, [ both / either or ] Hot-ro and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperatu -830 degree C by the continuous-annealing method. It cools to a room temperature and is 5 ppm about the amount of dissolution C in a steel plate. After considering as the following, temper rolling gives distortion of 40% or less 10% more. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm 2 It is Y.P (50%BH) 62 kgf(s)/mm above 2 The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting t below, and necked-in nature.

[0011] By weight %, (4) C:0.0020 - 0.0045%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminu 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.01%, [ both / either or ] Hot-ro and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperatu -830 degree C by the continuous-annealing method. It cools to a room temperature and is 5 ppm - 30 ppm about the amount of dissolution C in a steel plate. You make it remain. Then, temper rolling gives distortion of 30% or less 5% more by the pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm 2 Above, Y. The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting P (50%BH) to two or less [ 62 kgf(s)/mm ], and necked-in nature.

[0012] (5) Preceding clause (3) Or (4) It is the manufacture method of the surface treatment negative for DI cans excellent in the good pressure resistance of the flange processability beyond G.Sno:9.0 characterized by hot-rolling i the method of a publication by finishing 890 degrees C or more above 900 degrees C preferably at the time of hot rolling, and considering as a hot-rolling steel strip, and necked-in nature.

[0013] By weight %, (6) C:0.0005 - 0.0700%, Si: $\leq$ 0.30%, Mn:0.05-1.00%, P : $\leq$ 0.030%, S: $\leq$ 0.025%, sol.aluminu 0.002-0.100%, N: $\leq$ 0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.050%, [ both / either or ] Hot-r

and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. Cold-roll at 85 - 95% of rate of cold rolling, and recrystallization annealing is performed at recrystallizing-temperature -750 degree C by the box annealing method. Cool to a room temperature and temper rolling gives distortion of 40% less 10% or more by the pace of expansion after that. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> It is Y.P (50% BH) 62 kgf(s)/mm<sup>2</sup> above 2 The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below, and necked-in nature.

[0014] By weight %, (7) C:0.0005 - 0.0060%, Si:≤0.30%, Mn:0.05-1.00%, P :≤0.030%, S:≤0.025%, sol.aluminu 0.002-0.100%, N:≤0.0100%, B: Both 0-(0.0010+1.8xN %) %, and Nb and Ti : 0 - 0.050%, [ both / either or ] Hot-r and the cast piece which consists of a remainder unescapable impurity and iron is made into a hot-rolling steel strip. faces cold-rolling at 85 - 95% of rate of cold rolling, and carrying out recrystallization annealing after that.

Temperature region at least 500 degrees C or more is heated at recrystallizing-temperature -920 degree C by the 100 2500 degrees C [s ] heating rate. Carry out 0-10sec stay in the temperature region, perform recrystallization annealin and it cools to a room temperature. Then, temper rolling gives distortion of 40% or less 5% or more by the pace of expansion, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup> The manufacture method of the surface treatment negative for DI cans excellent in the good pressure resistance of the flange processability beyond G.Sno:9.0 characterized by adjusting to below, and necked-in nature.

[0015] this invention is described in detail below. It was called for that this invention person etc. maintains high intensity by one side first, it examined that there might be a steel plate property that the pressure resistance which the thing which were referred to as that it is called for that it is elasticity more on the other side, and to conflict excelled DI can demanded, and the outstanding necked-in nature may be reconciled, and found out that there was the possibil Below, the view which may be reconciled is explained.

[0016] First, it examined raising necked-in nature. In order to raise the necked-in nature of DI can, the method of lowering the deformation resistance of the necked-in section at the time of necked-in processing happens to think easily. First, although this invention person etc. investigated the applicability of the plating negative for DI cans by t box annealing method applied conventionally as a method of reducing the intensity of the plating negative before DI processing, a result said that a pressure resistance cannot secure at all was brought, and he checked anew that it was inapplicable with the elasticity former plating negative for DI cans.

[0017] Then, possibility of a steel plate that the pressure resistance which was excellent in DI can, and the outstanding necked-in nature might be reconciled was examined. Although it was just like that that the thing which were referred as that it is called for that surely intensity high at one side is called for, and the steel plate property that the pressure resistance which was excellent in this DI can, and the outstanding necked-in nature may be reconciled is elasticity m on the other side and to conflict was required, this invention person etc. examined that the pressure resistance of DI c and the intensity of the necked-in section were really what things. As conventionally shown also in the results of an investigation of the elasticity former [ above-mentioned ] plating negative for DI cans, the pressure resistance of DI c and the intensity of the necked-in section are proportional to the intensity of a negative, and if negative intensity is high, they will both become high. Therefore, it was thought that the improvement in the necked-in nature by lightweight-izing by on-the-strength elevation of a steel plate and elasticity-izing of a steel plate could be easily incompatible.

[0018] As a result of this invention person's etc. examining many things, the pressure resistance of DI can is the deformation resistance of the steel plate of the bottom section of DI can with which baking finish of back BH heat treatment by which DI processing was carried out was performed, and the deformation resistance is a deformation resistance of the part to which back (several% of processing distortion) BH heat treatment with which dome process of the bottom section was performed was performed. the contraction ratio of {sum total to which, as for the intensity the necked-in section, three ironing (ironing) processings were given after two draw forming on the other hand -- the drawing distortion and board thickness distortion of about 2.0 -- about 40%(equivalent to about 67% by pace of expansion)} -- processing to which BH heat treatment was performed further the back -- it is the deformation resistan of a very high distorted part Therefore, if there is a big difference that both intensity of these both differs in the deformation amount of beforehand both deformation greatly although it is the same in respect of the deformation resistance after BH heat treatment after deformation was performed beforehand and not the not necessarily same thin but the property of steel is fully utilized, the weighted solidity will notice it being the factor which can be changed respectively independently, will conduct various experiments, and will find out the steel of this invention. It is an ide that the deformation resistance after BH heat treatment after several% of processing is more high and the deformatio

resistance after BH heat treatment after about 40% of processing should just specifically be low steel more in board thickness distortion.

[0019] First, this invention person etc. performed examination for clarifying a target quality-of-the-material index us the steel variously made as an experiment in the pressure resistance of DI can, necked-in nature, and the conventiona T-4CA row based on this idea. As a result of making as an experiment and examining various steel plates, the pressu resistance of DI can and the intensity of the necked-in section found out that it could represent with Y.P (3%BH) and Y.P (50%BH) of a steel plate. in addition, the intensity of the necked-in section of DI can, although it is desirable to evaluate the deformation resistance after giving the very high distortion by about 40% (a pace of expansion 67%) by board thickness distortion originally \*\* As a result of investigating about various steel plates, it has by the deformati resistance at the time of 50% by the pace of expansion, and substitution of the measured value of the deformation resistance of 40% of board thickness distortion is fully possible, \*\* Measurement of the deformation resistance (yel stress by JIS-#5 test piece) after no less than 40% of high distortion was given by board thickness distortion Since variation arose in measured value that it is easy to be influenced of the process tolerance of the piece of a tensile test etc., it had the intensity of the necked-in section by Y.P (50%BH) of a steel plate, and it was made into the index val

[0020] Next, the conditions which reconcile the pressure resistance which was excellent in DI can, and the outstandi necked-in nature were examined. T-4CA for DI cans for which drawing 1 has so far been used for lightweight-izing, The steel plate which made Y.P of a negative high by adding P and Mn based on the aluminum-K steel of box annealing (BAF) currently used before, The steel plate which made Y.P of a negative high by changing C content an annealing conditions based on super-low carbon aluminum-K steel, and making the dissolution C in a steel plate increase, The steel plate which made Y.P of a negative high for Nb addition super-low carbon steel with the rate of temper rolling high at the base (it is described as Following HRT), While it is alike, attaching, building a negative w 0.220mm which is the board thickness at the time of a gage down and investigating the relation between Y.P of a negative, Y.P (3%BH), and Y.P (50%BH), it is drawing in which having performed tinning, having built DI can, having investigated a pressure resistance and necked-in nature, and having shown the result. For drawing 1 to pressu resistance, Y.P (3%BH) is 2 39 kgf(s)/mm. Pressure resistance can be secured above also at the time of a gage down and Y.P (50%BH) is 2 62 kgf(s)/mm about wrinkling generating at the time of necked-in one. It turns out that generating of a wrinkling is also lost below, and it turns out well that the surface treatment negative of this invention a negative for DI cans which has the outstanding pressure resistance and necked-in nature.

[0021] Furthermore, the point which should be noted is also understood that there are two points from the result of drawing 1 . The 1st point is about necked-in nature, and even if Y.P of a negative is high, while necked-in nature has good thing, even if Y.P of a negative is low, the thing of inferior necked-in nature is also a certain point. That is, it is the point which was able to show clearly that necked-in nature cannot be judged at all, but can be judged with the va of Y.P (50%BH) of the evaluation method of this invention from Y.P of a negative by this invention person's etc. investigation for the first time. The 2nd point adjusts C content to the steel plate and super-low carbon aluminum-K steel which P and Mn were added [ steel ] to BAF-aluminum-K steel, and only raised Y.P of a negative, as shown in drawing 1 . in the negative of only making the amount of dissolution C increase Although there is no range with whi necked-in nature and a pressure resistance are compatible, the steel plate Y. [ of a negative ] made high by HRT base on Nb addition super-low carbon steel is the point that it became clear that there is a compatible range, under a certai conditions.

[0022] As mentioned above, "Y. equipped with the main points of this invention as explained to the drawing 1 row above P (3%BH) More than 39 kgf(s)/mm<sup>2</sup> Y. surface treatment negative" for DI cans to which P (50%BH) is characterized by 62 kgf(s)/mm being two or less It is the outstanding plating negative for DI cans which becomes compatible with having reservation of the outstanding pressure resistance which can be borne also at the time of a ga down, and the outstanding necked-in nature, and it turns out that industrial value is very high.

[0023] Next, the steel plate which this invention person etc. made [ Y. / of a negative ] high by HRT based on Nb addition super-low carbon steel of drawing 1 examined the optimum conditions further under a certain conditions paying attention to there being a range with which a pressure resistance and necked-in nature are compatible. As a result, it is a claim (3). After making the 5 ppm of the amounts of dissolution C in a steel plate into the following, Temper rolling gives distortion of 40% or less 10% or more by the pace of expansion, and it is Y.P (3%BH) of a stee plate 39 kgf(s)/mm<sup>2</sup> Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup> The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below and necked-in nature" is



found out.

[0024] Moreover, the steel plate which made Y.P of a negative high by changing C content and annealing conditions based on the super-low carbon aluminum-K steel of drawing 1, and making the dissolution C in a steel plate increases. Paying attention to being effective in improving necked-in nature, further, the optimum conditions are examined and is a claim (4). by making 5 ppm - the 30 ppm of the amounts of dissolution C in a steel plate remain 30% of distortion is given 5% or more by the pace of expansion which made it possible to reduce the required rate of temper rolling. It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup>. It is Y.P (50%BH) 62 kgf(s)/mm<sup>2</sup> above 2. The method of the manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below and necked-in nature" is found out.

[0025] In addition, in order for the use to which severe flange processing is carried out especially to be also in DI cans and to apply to such a use, the more excellent flange processability is required. Then, this invention person etc. examined the steel plate property of being able to be equal also to such severe flange processing. First, it is the claim (3) of this invention about HRT which is one condition of a meta-RAJI means to attain this invention. (4) Although in the manufacturing method of a steel plate when the purpose differs both from a field of the invention. The manufacture conditions (manufacture conditions of the example of this official report) of the steel plate indicated by "JP,1-52451, currently indicated as a manufacturing method of the steel plate which a mere stretcher strain does not generate" of the manufacture method of giving HRT to reference A component, annealing, and the rate of temper rolling were changed. Many things were adjusted and it inquired so that it might become the weighted solidity of this invention steel plate, and flange processability was investigated. However, the result that there were some which run short of flange processability was brought. Then, although there is correlation remarkable between the diameter of crystal grain of an annealing board and flange processability, and flange processability is improved so that the diameter of crystal grain small as a result of examining many things about the weighted solidity of a steel plate, and the relation of flange processability, in order to investigate the cause. In the above-mentioned test coupon according to the manufacturing method of the example of the above-mentioned official report, since it was about 8.5 boards which have G.Sno [ fine grain seven to about 8.5 ], for acquiring, for acquiring sufficient flange processability, the diameter of crystal grain was too large, and it became clear that it is necessary to improve further.

[0026] As a result of this invention person's etc. examining how to carry out grain refining of the diameter of crystal grain of an annealing board, it turns out that influence with the big finishing temperature at the time of hot-rolling is done, it is making finishing temperature into 890 degrees C or more, G.Sno becomes 9.0 or more by the crystal grain of a hot-rolling board carrying out grain refining notably, and sufficient flange processability can also be secured. Furthermore, by making finishing temperature into 900 degrees C or more, G.Sno becomes 9.5 or more, and it also turns out that the more excellent flange processability is securable, and is a claim (2). A steel plate and claim (5) The method was able to be found out.

[0027] Claim (6) Claim (3) After making the 5 ppm of the amounts of dissolution C in a steel plate into the following. Temper rolling gives distortion of 40% or less 10% or more, and it is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup>. Above, Y. It is P (50%BH) 62 kgf(s)/mm<sup>2</sup>. About the method of adjusting to below" The amount of dissolution C in a steel plate is 5 ppm about this. How to apply to the box annealing method which becomes the following is examined "Are performed C:0.0005 - 0.0700% of aluminum-K steel by the box annealing method, and recrystallization anneal is performed at recrystallizing-temperature -750 degree C. Cool to a room temperature and temper rolling gives distortion of 40% or less 10% or more by the pace of expansion after that. It is Y.P (3%BH) of a steel plate 39 kgf (s)/mm<sup>2</sup>. It is Y.P (50%BH) 62 kgf(s)/mm<sup>2</sup> above 2. The manufacture method of the surface treatment negative for DI cans excellent in the pressure resistance characterized by adjusting to below and necked-in nature" is found out.

[0028] Furthermore, this invention person etc. is a claim (5) to which the diameter of crystal grain makes G.Sno 9.0 or more in the super-low carbon steel which is easy to become large. The option was also examined, temperature region least 500 degrees C or more was heated in s in 100-2500 degrees C /at the time of continuous annealing of a claim (3) and the method of carrying out recrystallization annealing which performs the retention for 5 or less seconds at recrystallizing-temperature -920 degree C was found out. By this method, it was not based on the finishing temperature of hot-rolling, but it became possible to make G.Sno of a steel plate or more into 9.5 further nine or more, and it also turns out that good flange processability is also securable.

[0029] The composition conditions of a steel plate are described in detail below. C needs to regulate a maximum value individually according to the manufacture conditions of each claim. Claim (1) (2) Since the amount of cementites of negative [ super-\*\*\*\*\* and ] of any manufacture conditions in a steel plate increased too much 0.0700% then and it

became impossible to have secured flange processability and necked-in nature, the upper limit was made into 0.0700%. Claim (3) It is 5 ppm about the amount of dissolution C in the steel plate after 0.0060% super-\*\*\*\*\* and continuous annealing. Since a lot of Nb(s), Ti, etc. had to be added, a lot of Nb(s) and Ti caused elevation of a recrystallizing temperature and it came to have exceeded 830 degrees C which can be annealed by the usual continuous-annealing method in order to have made it below, the upper limit was made into 0.0060%. Claim (4) It is 30 ppm about the amount of dissolution C in 0.0045% super-\*\*\*\*\* and a steel plate. Since it became impossible to have made it below the upper limit was made into 0.0045%. Claim (6) Claim (1) The upper limit was made into 0.0700% by the same reason.

[0030] Claim (7) It is 5 ppm about the amount of dissolution C in the steel plate after 0.0060% super-\*\*\*\*\* and continuous annealing. Since, as for a lot of Nb(s) and Ti, alloy cost became high too much by having to add a lot of N(s), Ti, etc. in order to have made it below, the upper limit was made into 0.0060%. In addition, since less than 0.0005% of thing could not build 0.0005% or more of a lower limit with the usual manufacturing method, it made the lower limit 0.0005%.

[0031] Each of Si, Mn, P, and S is the elements which affect the corrosion resistance of a steel plate greatly, and is  $\leq 0.30\%$ ,  $\leq 1.00\%$ ,  $\leq 0.30\%$ , and  $\leq 0.25\%$  from a corrosion resistance viewpoint, respectively. In addition, from a viewpoint of the ear dry-area nature at the time of hot-rolling, since Mn needed to be contained at least 0.05% or more it made the lower limit 0.05%. Since other Si, P, and S did not have an obstacle and a bird clapper at least, they did not regulate a lower limit.

[0032] sol.aluminum was used as a deoxidizer, and 0.002%, since it remained, the lower limit was made into 0.002%. Moreover, air oxidation of molten steel becomes easy to happen at the time of 0.100% super-\*\*\*\*\*, and casting, the amount of inclusion increased, and since it also came to have degraded processability and plating quality, 0.100% was made into the upper limit.

[0033] Since grain refining of crystal grain became remarkable and press-working-of-sheet-metal nature deteriorated when super-contained 0.0100%, N made the upper limit 0.0100%. In addition, however N may decrease, especially since it does not have a bad influence on the quality of the material, it is not necessary to regulate it.

[0034] What is necessary is just to add B suitably to fix N as BN and elasticity-ize a steel plate. Since hard-ization according [ B content ] to solid solution strengthening of  $0.0010+1.8 \times N$  % super-\*\*\*\*\*, and B became remarkable, the upper limit was made into  $0.0010+1.8 \times N$  %.

[0035] Although what is necessary is just to have added when the diameter of crystal grain of a higher r value or an annealing board is made into a fine grain, or low Y.P (50%BH) was obtained more as shown also in drawing 1, and necked-in nature wants to have improved further, since alloy cost just became [ Nb, Ti, or Nb+Ti ] high also in 0.050% super-\*\*\*\*\* and the improvement effect of the quality of the material came to be saturated, Nb and Ti made the upper limit 0.050%. Claim (3) In the case, since 0.030% super-\*\*\*\*\*, and the recrystallizing temperature at the time of continuous annealing came to have exceeded 830 degrees C, Nb, Ti, or Nb+Ti made the upper limit 0.030%. Claim (4) A case is 5 ppm about the required amount of dissolution C, if Nb, Ti, or Nb+Ti exceeds 0.010%. Since it became impossible to have made it remain above, the upper limit was made into 0.010%. Claim (6) (7) Since the improvement effect of the quality of the material came to be saturated with about [ that alloy cost becomes / Nb, Ti, or Nb+Ti / high 0.050% also in super-\*\*\*\*\* ], the case also made the upper limit 0.050%.

[0036] In order to reconcile the outstanding necked-in nature with the outstanding pressure resistance as a quality-of-the-material index of a steel plate As mentioned above, since "it is Y.P (50%BH) more than 39 kgf(s)/mm<sup>2</sup> about Y. (3%BH) of a steel plate Below 62 kgf(s)/mm<sup>2</sup>" is indispensable It is Y.P (3%BH) of a steel plate 39 kgf(s)/mm<sup>2</sup> Y.P (50%BH) was regulated or less [ 62 kgf(s)/mm ] to two above.

[0037] The amount of dissolution C is one of the points of this invention, and is a claim (4). By the method As shown in drawing 1, it is Y.P (50%BH) 62 kgf(s)/mm<sup>2</sup> 34kgf/mm<sup>2</sup> [ required to be the following and secure a pressure resistance ] Maintenance of Y.P (3%BH) Rationalization of the amount of dissolution C is also important, and it is 5 ppm. Since reservation of the pressure resistance excellent in less than 10% of rate of temper rolling becomes difficult in the following, it is 5 ppm about a lower limit. It carried out. moreover, the amount of dissolution C -- 30 ppm since reservation of the necked-in nature which was excellent even if it made combination of super-\*\*\*\*\* and HRT into optimal conditions, and the outstanding necked-in nature becomes difficult -- a upper limit -- 30 ppm -- it carried in addition, claim (3) a method -- the upper limit of the amount of dissolution C in a steel plate -- 5 ppm having considered as the following -- the amount of dissolution C in a steel plate -- 5 ppm super-\*\*\*s -- \*\*\*\* -- claim (4) in which low temper rolling is more possible since it becomes advantageous economically to apply a method -- this --

claim (3) It writes that it is out of range, and comes out.

[0038] Hereafter, manufacture conditions other than the component composition condition of a steel plate are described in detail. If it is the method by which the component of the steel of each claim is obtained, what method is sufficient the manufacture conditions of a cast piece, and it is not necessary to regulate them especially. The method of carrying out rolling between post heating which inserted the piece of heat in the heating furnace also by the method of hot-rolling directly the piece of heat which it is not necessary to regulate especially, and the usual hot-rolling conditions sufficient as, and was manufactured by the continuous casting for energy saving is sufficient also as hot-rolling conditions. Moreover, although it is not necessary to also regulate especially rolling-up temperature, when it is going to obtain elasticity material, it is good to adopt inside elevated-temperature rolling up. In addition, it is a claim (5) when acquiring the more excellent flange processability. 900 degrees C or more 890 degrees C or more are preferably good in finishing temperature so that it may regulate.

[0039] Since the rate of cold rolling influences the earing of DI can greatly, it is necessary to make it into 85 - 95%. In addition, in order to obtain the rate of an earing near zero, it is desirable to tune finely in consideration of the component of steel, hot-rolling conditions, and annealing conditions.

[0040] Recrystallization annealing conditions are a claim (3) although it changes greatly with annealing methods. What is necessary is to perform recrystallization annealing at recrystallizing-temperature -830 degree C, and just to carry out cooling to a room temperature after that by the usual continuous-annealing method [ like ]. In addition, the annealing temperature was made into 830 degrees C or less because 830-degree-C super-\*\*\*\*\* and a steel plate became soft, troubles, such as being prolonged during plate leaping, occurred and annealing became impossible. On the other hand claim (7) also call it an annealing machine like [ it is quick 2 figures at the heating rate of the method of annealing, and ] a completely different machine from the conventional continuous annealing furnace short about 2 figures in annealing time -- \*\* -- in the new annealing facility, since it was [ that what is necessary is for the limit from plate-leaping nature not to have the upper limit of an annealing temperature, and just to determine from the quality of the material ] permissible to the temperature which does not go into an austenite, the upper limit was made into more than [ moreover, / heating temperature region at least 500 degrees C or more by the heating rate 100 degrees C //s / or more in order to acquire the grain-refining effect of the diameter of crystal grain of an annealing board and more than a recrystallizing temperature ] -- the residence time in a temperature region 920 degrees C or less -- 10sec(s) There is a need of considering as the following. In addition, in the heating rate beyond it, since the heating rate was too quick a control of heating terminal point temperature became difficult, having carried out the upper limit of a heating rate in 2500 degrees C/s carried out the upper limit in 2500 degrees C/s.

[0041] Temper rolling is an important element in composition of a steel plate, and adjustment of the amount of dissolution C, in order to make it "being Y.P (50%BH) more than 39 kgf(s)/mm<sup>2</sup> about Y.P (3%BH) of a steel plate Below 62 kgf(s)/mm<sup>2</sup>". [ which is one of the important points of the steel plate of this invention ] Claim (3), As shown in (6), the amount of dissolution C of a steel plate is 5 ppm. Since reservation of "being Y.P (3%BH) of a steel plate More than 39 kgf(s)/mm<sup>2</sup>" for the rate of temper rolling securing a pressure resistance at less than 10% when it is the following became impossible, the lower limit was made into 10%. In addition, that it is easy to generate a crack at the time of the spinning at the time of DI processing, with the bird clapper, since the economical loss increased in coming out enough at 40% for maintaining the pressure resistance of the present condition level which the steel plate of this invention makes the purpose, and giving a certain thing and the further more high rate of temper rolling, having made the upper limit into 40% made the upper limit 40% again. Claim (7) A upper limit is also the same reason. Claim (4) The amount of dissolution C of a steel plate is 30 ppm. Since the rate of temper rolling became impossible at less than 5.0% as for reservation of "being Y.P (3%BH) of a steel plate More than 39 kgf(s)/mm<sup>2</sup>" even if it made [ many / to below ] it, the lower limit was made into 5.0%. In addition, for having made the upper limit into 30%, Dissolution C 5-30 ppm. Since it contained mostly and reservation of flange processability became difficult at the rate of temper rolling of \*\* 30%, the upper limit was made into 30%.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is drawing showing a relation with Y.P (50%BH) in Y.P of a negative, and a Y.P (3%BH) row.

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[Translation done.]

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EXAMPLE

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[Example] It is a book below. The 0.220mm surface treatment negative which is the board thickness at the time of a gage down was manufactured to Table 1 in a component and Table 2 on continuation hot-rolling, cold rolling, continuous annealing, temper rolling, and conditions. The amount of dissolution C of the manufactured surface treatment negative, Y.P (3%BH), and Y.P (50%BH) were measured. Moreover, DI performance after Sn plating was investigated. The result is shown in Table 3.

[0043] Steel A, B, C, D, E, and F is all the steel of component within the limits of this invention, and is Steel A. The example and Steel B with which the amount of C added Nb 0.006% at 0.0025% As for the example which added Ti 0.025%, and Steel C, 0.007%, the example which added B 0.0008%, and Steel D Nb Even if C makes it fall extreme with 0.0011% and does not add Nb and Ti, the amount of dissolution C after annealing is 5 ppm. The example and Steel E which become the following are a claim (1). Although it is within the limits of (2) claim (4) if there are too many C contents on manufacture conditions -- the example of comparison -- becoming -- namely, C content -- 0.005 -- many -- the dissolution C content after annealing -- 35 ppm the example and Steel F which became -- C content -- example of C content of 0.0410% and the usual low carbon aluminum-K steel -- it comes out

[0044] Set in samples 1, 2, 8, 9, and 10. The steel with which, as for steel 1 and 2, the amount of C added Nb 0.006% 0.0025%, As for the steel with which steel 8 added Ti 0.025%, and steel 9, 0.007%, the steel which added B 0.0008% and steel 10 Nb Even if C makes it fall extremely with 0.0011% and does not add Nb and Ti, the amount of dissolution C after annealing is 5 ppm. The steel made into the following is used. All are the claims (3) of this invention. (4) Or It is an example. this invention carried out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, board thickness secured the pressure resistance at the time of 0.220mm and the further gage down and the outstanding necked-in nature was obtained. Moreover, separately, as a result of evaluating flange processability, it is a claim (5). As for the samples 2, 8, 9, and 10 of an example, flange processability with crystal grain good at a fine grain was acquired by each.

[0045] For samples 3 and 4, a sample 2 and the rate of temper rolling are the claim (5) of 7.0%, 1.0%, and this invention. Y.P (3%BH) of the target quality-of-the-material [ are an example of comparison and / this invention ]-all index which separated from the range of the rate of temper rolling is 2 34.26 kgf(s)/mm. It separated low and the pressure resistance at the time of a gage down has not been secured. The steel with which the amount of C added Nb 0.006% at 0.0025% is used for a sample 5, and it is the claim (6) of this invention. It is the example applied to the board annealing method, and the invention in this application carries out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, the pressure resistance at the time of a gage down is secured, and the outstanding necked-in nature is obtained.

[0046] For a sample 6, the rate of temper rolling is the claim (6) of 1.0% and this invention. Y.P (3%BH) of the target quality-of-the-material [ are an example of comparison and / this invention ] index which separated from the range of the rate of temper rolling is 2 25 kgf(s)/mm. It separates low and the pressure resistance cannot be secured. The steel with which the amount of C added Nb 0.006% at 0.0025% is used for a sample 7, and it is the claim (7) of this invention. It is the example applied to the super-rapid heating short-time annealing method, and this invention carries out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, the pressure resistance at the time of a gage down is secured, and the outstanding necked-in nature is obtained Moreover, as a result of evaluating flange processability, the flange processability which G.Sno is 10.6 with the fine grain notably, and was excellent was acquired.

[0047] A sample 11 is a claim (1). It is a claim (4) although it is within the limits of (2). On manufacture conditions, content is the example of comparison which are. That is, there are many C contents as 0.0055%, and the dissolution

content after annealing is 35 ppm. Y.P (50%BH) of a target quality-of-the-material [ are the example of comparison which became and / this invention ] index is 2 65 kgf(s)/mm. It separates highly and the outstanding necked-in nature cannot be secured. 0.041% and the usual low carbon aluminum-K steel are used for a sample 12 for C content, and it the claim (6) of this invention. It is the example applied to the box annealing method, and this invention carries out clear [ of the Y.P (50%BH) ] to the Y.P (3%BH) row of a target quality-of-the-material index, a pressure resistance is secured and the outstanding necked-in nature is obtained.

[0048] For a sample 13, a sample 12 and the rate of temper rolling are the claim (6) of 1.0% and this invention. Y.P (3%BH) of the target quality-of-the-material [ are an example of comparison and / this invention ] index which separated from the range of the rate of temper rolling is 2 26 kgf(s)/mm. It separates low and the pressure resistance the time of a gage down cannot be secured. For a sample 14, Y.P (50%BH) of a target quality-of-the-material [ are the conventional example of T-4CA for the conventional DI cans, and / this invention ] index is 2 66 kgf(s)/mm. It separated highly and the wrinkling has occurred at the time of necked-in one.

[0049] clear from the result of the above example -- as -- "Y. of the main points of the steel plate of this invention -- (3%BH) more than 39 kgf(s)/mm<sup>2</sup> Y. P (50%BH) is 2 62 kgf(s)/mm. The surface treatment negative for DI cans characterized by being the following" That industrial value is very high at the plating negative for DI cans which has outstanding DI can processability which becomes compatible and the claim (3) of having reservation of the pressure resistance at the time of a gage down, and the outstanding necked-in nature - (7) The manufacture method. It turns out that it can manufacture.

[0050]

[Table 1]

鋼	成 分 (％)									備 考
	C	Mn	P	S	sol. Al	N	B	Nb	Ti	
A	0.0025	0.10	0.010	0.006	0.043	0.0018	Tr	0.006	Tr	発明内
B	0.0020	0.11	0.009	0.012	0.053	0.0016	Tr	Tr	0.025	発明内
C	0.0024	0.10	0.011	0.007	0.044	0.0018	0.008	0.007	Tr	発明内
D	0.0011	0.10	0.012	0.008	0.050	0.0019	Tr	Tr	Tr	発明内
E	0.0055	0.20	0.015	0.010	0.043	0.0020	Tr	Tr	Tr	発明内
F	0.0410	0.25	0.012	0.008	0.055	0.0014	Tr	Tr	Tr	発明内

[0051]  
[Table 2]

[0052]  
[Table 3]

試料	供試鋼	熱延		連統焼鈍			調圧 (%)	備考		
		SRT (°C)	F. T (°C)	C. T (°C)	方式	連統焼鈍				
						H. R (°C/s)	S. T×t (°C)		t (sec)	
1	A	1150	860	650	CAL	20	770×20.0s	0	20.0	請求項(3), (4)
2	A	1150	925	650	CAL	20	770×20.0s	0	20.0	請求項(5)
3	A	1150	925	650	CAL	20	770×20.0s	0	7.0	比較例
4	A	1150	925	650	CAL	20	770×20.0s	0	1.0	比較例
5	A	1150	925	650	BAF		660×15Hr		20.0	請求項(6)
6	A	1150	925	650	BAF		660×15Hr		1.0	比較例
7	A	1150	925	650	N-CAL	1000	800×0.3	0	20.0	請求項(7)
8	B	1200	925	650	CAL	20	750×20.0s	0	15.0	請求項(5)
9	C	1200	925	650	CAL	20	750×20.0s	0	15.0	請求項(5)
10	D	1100	925	580	CAL	20	650×20.0s	0	20.0	請求項(5)
11	E	1100	925	620	CAL	20	660×20.0s	0	15.0	比較例
12	F	1240	880	550	BAF		640×5Hr		15.0	請求項(6)
13	F	1240	880	550	BAF		640×5Hr		1.0	比較例
14	F	1200	880	550	CAL	20	640×20.0s	0	1.0	従来例

但し、SRT：スラブ加熱温度、F. T：熱延仕上温度、C. T：巻き取り温度

H. R：加熱速度、S. T：均熱温度、t1：均熱時間、t0A：450 °Cでの過時効処理時間

CAL：通常の連統焼鈍法、N-CAL：請求項(7)のような超急速加熱短時間焼鈍法



試料	評価結果					備考
	固溶C (ppm)	Y. P (3%BH) (kgf/mm <sup>2</sup> )	Y. P (50%BH) (kgf/mm <sup>2</sup> )	D I 性能		
				耐圧強度	ネックドイン性	
1	1	44	57	○	○	請求項(3), (4)
2	1	45	57	○	○	請求項(5)
3	1	34	53	×	○	比較例
4	1	26	52	×	○	比較例
5	0	44	56	○	○	請求項(6)
6	0	25	52	×	○	比較例
7	1	45	57	○	○	請求項(7)
8	1	41	55	○	○	請求項(5)
9	1	42	55	○	○	請求項(5)
10	3	44	56	○	○	請求項(5)
11	35	47	65	○	×	比較例
12	0	41	55	○	○	請求項(6)
13	0	26	53	×	○	比較例
14	45	44	66	○	×	従来例

耐圧強度 : ボトム部の耐圧強度の評価 (○ : 合格、× : 不足)

ネックドイン性 : ネックドイン性の評価 (○ : 合格、× : しわ発し)

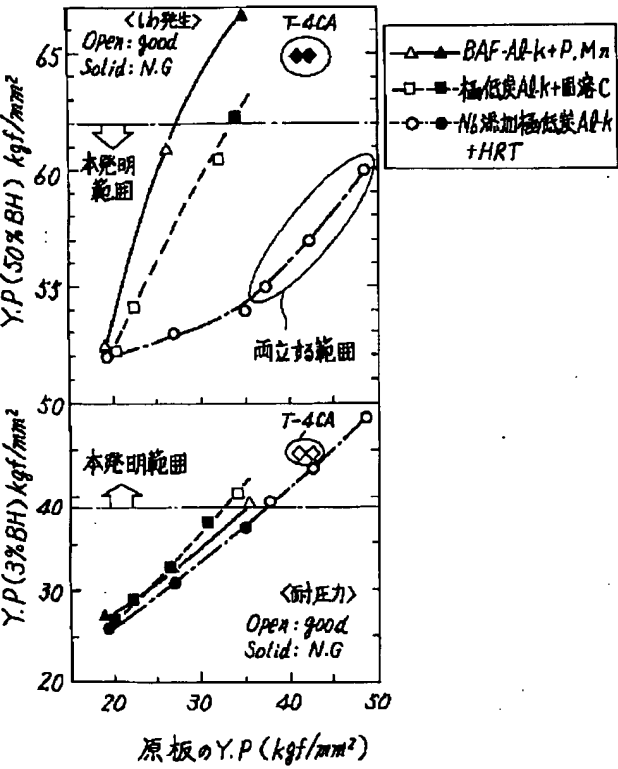
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DRAWINGS

[Drawing 1]



[Translation done.]